

Product Safety Assessment

DOW™ Ethylene Oxide

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Names

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|-----------------------|---------------------|-------------------|
| • CAS No. 75-21-8 | • DOW™ EO | • Epoxyethane |
| • Ethylene oxide | • Dimethylene oxide | • Oxacyclopropane |
| • DOW™ ethylene oxide | • Oxirane | • ETO |
| • EO | • Dihydrooxirene | • Ethene oxide |

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Product Overview

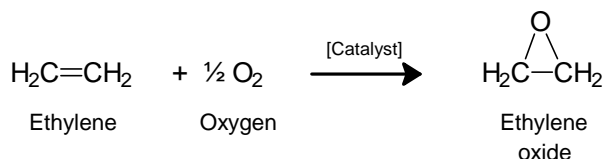
- DOW™ ethylene oxide (EO) is a colorless, flammable, reactive material with a somewhat sweet, ether-like odor.¹ See [Product Description](#).
- Ethylene oxide is usually stored and/or transported as a liquid under pressure. It is used in the production of ethylene glycol and other oxide derivatives such as glycol ethers, polyethylene glycol, polyether polyols, diethylene and triethylene glycols, and ethanolamines. It is also used in the manufacture of flexible and rigid polyurethane foams, brake fluids, and water-soluble solvents.² See [Product Uses](#).
- Ethylene oxide overexposure by short-term or long-term vapor inhalation or contact with ethylene oxide vapor or liquid can cause a wide variety of harmful health effects. Single exposures to the liquid or vapor have the potential to damage the eyes, skin, mucous membranes, and respiratory tract. Such exposures can also cause problems in the functioning of the brain and nerves. Ethylene oxide is classified as a carcinogen and a reproductive hazard for humans.³ See [Health Information](#).
- Dow does not sell EO for direct consumer use. Dow supports the sale of EO only for use in industrial applications and will not knowingly sell into unsupported applications.**Error! Bookmark not defined.** Direct consumer exposure to Dow EO is unlikely.
- Ethylene oxide reacts with many industrial chemicals, generally with a release of heat, and will rapidly polymerize when in contact with certain catalytic materials. The generation of heat resulting from these reactions can overpressure and rupture closed vessels. EO vapor will decompose rapidly above 930°F (500°C). Decomposition of EO in a closed vessel can result in a rapid pressure buildup leading to vessel overpressure and catastrophic failure. Ethylene oxide vapor has a wide flammability range in air. Vapor-air mixtures will ignite when exposed to relatively low levels of energy.⁴ See [Physical Hazard Information](#).
- Releases of EO liquid or vapor do not persist in the environment. Ethylene oxide has low to moderate aquatic toxicity and will not bioconcentrate (accumulate in the food chain). See [Environmental Information](#).

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Manufacture of Product

- **Location** –Dow, along with its subsidiaries and affiliates, produces EO in Canada, Kuwait, The Netherlands, and the United States.
- **Process**⁵ – The dominant process for making EO is the vapor-phase oxidation of ethylene with oxygen or air over a catalyst at high temperature and pressure. The reaction is shown below. Dow uses a proprietary variation of this process.



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Product Description^{1,3}

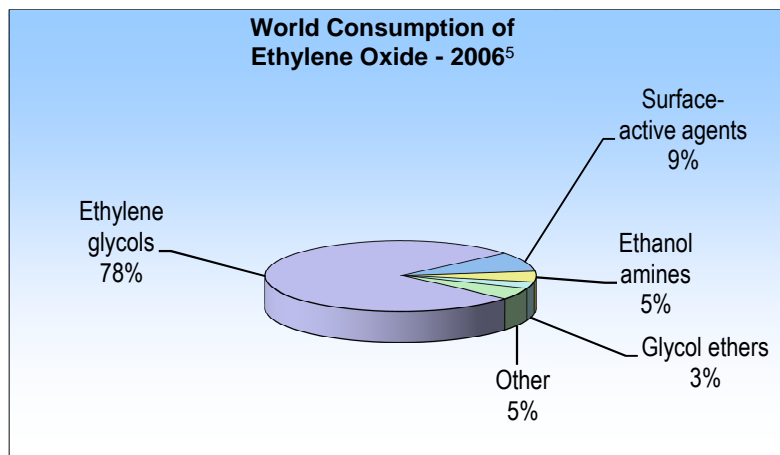
DOW™ ethylene oxide is a colorless gas or liquid with a somewhat sweet, ether-like odor. It dissolves in water, alcohol, and most organic solvents. EO is the simplest cyclic ether; and because its highly strained ring can be opened easily, EO is highly reactive.

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Product Uses³Error! Bookmark not defined.⁵

EO is used primarily to make other chemicals, especially [ethylene glycol](#) (a chemical used to make antifreeze and polyester), surface-active agents, ethanolamines, and glycol ethers.

Derivatives of EO (especially ethylene glycol) are commonly used in the plastics industry for manufacturing bottles and to produce polyester fibers (for clothing and furniture), automotive coolants, industrial coolants, heat-transfer fluids, detergents, and surfactants. EO is also an intermediate used in the manufacture of flexible and rigid polyurethane foams, brake fluids, and water-soluble solvents.



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Exposure Potential³

Ethylene oxide is used in the production of certain industrial and consumer products. Based on the uses for EO, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in an EO manufacturing facility or in the various industrial or manufacturing facilities that use EO. EO is produced, distributed, stored,

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and consumed in closed systems. Those working with EO in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing facility should have a thorough training program for employees and appropriate work processes and safety equipment in place to prevent EO exposure. See [Health Information](#).

- **Consumer exposure to products containing DOW™ ethylene oxide** – DOW EO is used as a raw material in the manufacture of other chemicals used in many products. Dow does not sell EO for direct consumer use. Dow supports the sale of EO only for use in industrial applications and will not knowingly sell into unsupported applications. **Error! Bookmark not defined.** Direct consumer exposure to DOW EO is unlikely. See [Health Information](#).
- **Environmental releases⁶** – In the event of a spill, the focus must be on containing the spill and preventing contamination of soil and surface or ground water. Due to its high vapor pressure, EO easily evaporates to the air. Respiratory protection is therefore necessary for cleaning up spills and leaks. The possibility that EO will form a flammable mixture in air cannot be disregarded, and the use of fire-resistant clothing may be necessary. Eliminate all sources of ignition immediately. Knock down vapors with water fog or spray. When using water spray, small quantities may actually accelerate vaporization and worsen conditions. Large quantities of water are necessary to effectively knock down EO vapors and dilute spills. Do NOT use absorbent materials such as clay. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).
- **Large release⁶** – Industrial spills or releases of EO are infrequent. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Positive pressure, self-contained breathing apparatus (SCBA) with a full-face mask approved by NIOSH and EO resistant chemical clothing is recommended for emergency work. Eliminate all sources of ignition immediately. Use only explosion-proof equipment; ground and bond all containers and handling equipment. Vapors are heavier than air and may travel a long distance and accumulate in low-lying areas. Keep vapors out of sewers. The public should be warned of downwind vapor hazards. Follow emergency procedures carefully. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).
- **In case of fire** – Deny unnecessary entry into the area and consider the use of unmanned hose holders. A significant volume of water should be applied in many EO emergency scenarios. Although EO reacts with water, responders should not hesitate to apply water in situations where EO has been released to the environment, since the hazard of fire and personnel exposure is far more significant than the hazard of an EO/water reaction. However, use of a direct water stream may spread fire. Keep fire-exposed containers and nearby equipment cool using water spray. In case of sounds from venting safety device or discolorations of the container, immediately withdraw all personnel from the area. Be alert to the possibility that EO exposed to fire can be heated to 930°F (500°C), the temperature at which it decomposes rapidly. Relief valves are not designed to handle a decomposition reaction or polymerization. After the fire has been extinguished, continue to apply large volumes of water to dilute the EO, which will minimize the potential for reignition or a vapor cloud explosion. See [Physical Hazard Information](#).

For more information, request the relevant Safety Data Sheet from the [Dow Customer Information Group](#).

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Health Information^{3,7}

Because of its high vapor pressure, the greatest potential for ethylene oxide exposure is *via* inhalation. In addition, the odor threshold for EO is too high to provide adequate warning of hazardous concentrations. Short-term exposures to EO vapors can result in irritation of exposed surfaces, including eyes, skin, nose, throat, and lungs. Irritation of the lungs can lead to

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secondary infections, which can lead to pneumonia. Short-term exposures can also affect the central nervous system, leading to symptoms such as drowsiness, disorientation, nausea, and vomiting. Convulsions and limb weakness can also occur. These symptoms often reverse within a few days after cessation of acute exposure.

Liquid ethylene oxide can cause freezing of the skin by evaporative cooling. It is also highly irritating to the eyes and skin, and even dilute solutions can cause blistering or severe damage to the skin or eyes. EO liquid and solutions easily and rapidly penetrate cloth, leather, and many of the materials used in personal chemical-protection equipment. If clothing or footwear contaminated with EO is not removed immediately, blistering can occur.

Long-term exposure to EO may also result in neurological effects similar to those observed in cases of acute short-term exposure, such as headaches, nausea, lethargy, numbness, and memory loss. There may also be a reduced sense of smell and/or taste and muscle weakness, particularly in the legs. The potential short-term and long-term effects of EO on the nervous system are considered reversible.

EO is capable of directly combining with proteins and DNA when absorbed into body tissues to form various adducts to protein and DNA. Based primarily on animal data and on cytogenetic changes in highly exposed workers, the International Agency for Research in Cancer (IARC) classifies EO as a known human carcinogen. Studies in animals have shown that breathing ethylene oxide at high levels can interfere with reproduction. Litter sizes were smaller than usual, and the offspring of exposed animals weighed less than normal and had slightly delayed bone formation.

For more information, request the relevant Safety Data Sheet from the [Dow Customer Information Group](#).

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Environmental Information^{3,8}

Under normal conditions, ethylene oxide exists as a gas, and most EO emissions eventually migrate to the atmosphere. Although EO is somewhat persistent in the atmosphere, evidence indicates that it ultimately degrades by photolytic processes. Based on its chemical and physical properties, ethylene oxide in soil would be expected to volatilize, leach through the soil, or be removed by runoff during rainstorms. It is unlikely that ethylene oxide will accumulate in soils or sediments. If absorbed in soils, bacteria and other organisms will convert EO to the readily biodegradable ethylene glycol within a few days. EO does not persist in water due to rapid evolution to the air and conversion to ethylene glycol by hydrolysis or degradation of hydrolysis products.

EO has low to moderate aquatic toxicity. EO does not bioconcentrate (accumulate in the food chain).

For more information, request the relevant Safety Data Sheet from the [Dow Customer Information Group](#).

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Physical Hazard Information^{1,4}

Ethylene oxide reacts with many chemicals, and the resulting reactions often generate heat. Failure to prevent the buildup of heat from these reactions or from the polymerization of EO contained in fixed volume vessels can lead to pressure buildup and eventual vessel failure.

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Loss of containment when a vessel fails will result in the formation of an EO vapor cloud. The ignition energy of EO in air is low for its entire flammability range and ignition should be considered likely. Ignition of a vapor cloud can cause significant damage to facilities and severe injury to personnel. Clouds which do not ignite may cover large areas before they are diluted to an EO concentration which will not harm individuals.

The decomposition reaction of EO vapors can produce flammable and explosive reaction products including ethane, ethylene, hydrogen, CO₂, and acetaldehyde. EO can also ignite and decompose explosively below atmospheric pressures. High pressure can be generated by the decomposition of EO. The risk of vapor decomposition can be minimized by blanketing with a suitable inert gas such as nitrogen.

Ethylene oxide can also polymerize with the release of heat. Formation of EO polymer is a function of temperature, time at temperature, and exposure to catalysts or contaminants, but can occur at ambient temperatures.

For more information, request the relevant Safety Data Sheet from the [Dow Customer Information Group](#).

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Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of ethylene oxide. These regulations may vary by city, state, country, or geographic region. Information may be found by requesting the Technical Data Sheet, using [Contact Us](#), or requesting the relevant Safety Data Sheet from the [Dow Customer Information Group](#).

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Additional Information

- Request the relevant Safety Data Sheet from the [Dow Customer Information Group](#) (<http://www.dow.com/assistance/dowcig.htm>)
- Contact Us (<http://www.dow.com/ethyleneoxide/contact/index.htm>)
- *Toxicological Profile for Ethylene Oxide*, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service, December 1990 (<http://www.atsdr.cdc.gov/toxprofiles/tp137-p.pdf>)
- *Ethylene Oxide Product Stewardship Guidance Manual, Third Edition*, American Chemistry Council, May 2007
- Devanney, Michael T., "Ethylene Oxide," *CEH Marketing Report: Chemical Economics Handbook*, SRI Consulting, April 2007

For more business information about DOW™ ethylene oxide, visit Dow's ethylene oxide web site at <http://www.DowEO.com> or <http://www.dow.com/ethyleneoxide/index.htm>.

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References

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- ² Dow Ethylene Oxide website: <http://www.dow.com/ethyleneoxide>
- ³ *Toxicological Profile for Ethylene Oxide*, Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Service, December 1990
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- ⁷ "Health Effects of Ethylene Oxide," *Ethylene Oxide Product Stewardship Guidance Manual, Third Edition*, American Chemistry Council, May 2007
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NOTICES:

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Safety Data Sheet.

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